Greener technologies in by-products and wastes processing - the case of electric fields in extraction and proteins functional modification

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Several technologies utilizing electrical fields directly into food processing, such as pulsed electric fields and ohmic heating, are currently being used on a commercial scale for of an extensive range of food products. They have shown to be environmentally clean technologies (at least locally), that can bring added-value to the products, improving the overall energy efficiency of the process and reducing the use of non-renewable resources [1]. During the last decade, much research on ohmic heating and the effects of its moderate electric fields has been addressed with a view to combating pathogens and improving the nutritional and sensorial properties of thermal processed food. Recently it has been demonstrated that electro-heating appears also as an interesting processing tool to be used in extraction of bioactive compounds from food by-products, as well as a way to modulate functional and technological aspects of important food ingredients, such as whey proteins. Results shows that the presence of electric fields during heating contributes to a change thermodynamic and kinetic behaviour of protein denaturation, as well in the shape of produced aggregates, highlighting the influence of non-thermal effects. Transmission electron microscopy unveils that the morphology of the protein aggregates is different under the influence of electric effects, which seems to increase the appearance of dispersed short fibrillar structures. Electro-heating treatment can be designed together with gelation techniques for the development of biodegradable protein-based gels as potential devices for the incorporation of food nutraceuticals, thus creating novel applications not only for food industries, but also in the pharmaceutical area; results have shown that 33 mmol.L^{-1} of Fe^{2+} can be associated to a whey protein gel network providing an opportunity for the development of innovative functional foods that can be used as an oral dietary supplement. Electrical and thermal effects can be optimized into a single step treatment enhancing thermal stabilization (i.e. inactivation of microorganism and enzymes) and extraction of anthocyanins and phenolic compounds from vegetable and fruit tissues. Electro-heating at high electric field (200 V/cm) and high temperature (~100 ºC) enhanced considerably the extraction of chlorogenic acid from purple potato wastes, but also allowed to extract ellagic and ferulic acids, catechin and rutin in a very comparable way to a freeze/thawing treatments Electro-heating capability of applying high heating rates with a precise temperature control together with putative electroporation effects in cell tissues presents an interesting solution for several biotechnological processes.

[1] Pereira, R. N., & Vicente, A. A. Environmental impact of novel thermal and non-thermal technologies in food processing. Food Research International, 43(7), 1936-1943, 2010.